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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/920,978	08/01/2001	Shane J. Trapp	MI22-1674	6594

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EXAMINER
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BLUM, DAVID S

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 05/30/2002

#5

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/920,978

Applicant(s)

TRAPP, SHANE J.

Examiner

David S Blum

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 26 April 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-12, 14-33 and 35-45 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-12, 14-33 and 35-45 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

**DETAILED ACTION**

***Claim Rejections - 35 USC § 112***

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1-5 and 8-15, 16-17, 19 and 21, 22-26 and 29-32, 37-39, 41 and 43 rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Dependent claims 1, 16, 22, and 37 contain the limitation "consisting essentially of reactive components of...". The specification (page 6 and original claims recited "comprising". The amendment to "consisting essentially" limits the scope of the invention other than the metes and bounds of the original presentation. The addition of "reactive components" is also new matter to the original presentation.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 18 and 44, 40 and 45 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

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Independent claims 18 and 40 limit the invention to using an etching chemistry with a volumetric ratio of all fluorocarbon to ammonia of ranging from 40:1 to 3:1 and also from no less than 9:1. The two ratios in the same claim are in conflict with each other. Also, in claim 18, it is possible to read the second ratio (at least 9:1) as being the ratio of fluorocarbons to ammonia in a condition without ammonia. If this condition existed, there could be no ratio.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 6, 18, 27, and 40, are rejected under 35 U.S.C. 103(a) as being unpatentable over Wolf in view of Ding (US 5,814,563).

Wolf teaches all of the positive steps of claims 6, 18, 27, and 40 except for the use of ammonia as the source of hydrogen and various and multiple fluorocarbons, hydrocarbons, chlorofluorocarbons and chlorohydrocarbons.

Wolf (page 40 volume 2 teaches etching a trench in a semiconductor by etching through a patterned mask of pad oxide, nitride layer and photoresist, and into the silicon substrate. Wolf also teaches (pages 555-557 volume 1) anisotropic plasma etching

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through the mask and into the substrate using a dry etch of  $\text{CF}_4$  gas and that the shape of the trench (result of etch selectivity) can be altered by adjusting the fluorine-to-carbon ratio with hydrogen additions and altering the etch chemistry to make the etchant more selective toward the photoresist. Wolf teaches the chlorofluorine gas for etching nitride, silicon oxide, and silicon.

Ding teaches etching silicon oxide using fluorohydrocarbon gasses in an etching chemistry containing ammonia ( $\text{NH}_3$ , a source of hydrogen, abstract) and in a magnetic field (magnetically enhanced plasma etching column 5 lines 13-15), the preferred volumetric ratio of fluorohydrocarbon to ammonia is 2.5: to 7:1 (column 2 line 57) which encompasses limitations of 40:1 to 3:1. Ding's figure 3 also shows that volumetric ratios of 10+:1 were also used, thus encompassing the limitations of "no less than 9:1. Ding also teaches using a combination of two fluorocarbons (column 9 line 65-column 10 line 4).

One skilled in the requisite art at the time of the invention would modify Wolf by including multiple fluorocarbons in conjunction with ammonia as a hydrogen source with reasonable expectation of producing a trench with better control of the etch profile angle (Ding column 1 line 55, Wolf page 552).

7. Claims 12, 20, 33 and 35, and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wolf in view of Ding (US 5,814,563) and JP 200-349071.

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Wolf teaches all of the positive steps of claims 6, 18, 27, and 40 except for the use of ammonia as the source of hydrogen and various and multiple fluorocarbons, hydrocarbons, chlorofluorocarbons and chlorohydrocarbons, the fluorocarbons consisting of one of C<sub>4</sub>F<sub>6</sub> and C<sub>5</sub>F<sub>8</sub>.

Wolf (page 40 volume 2 teaches etching a trench in a semiconductor by etching through a patterned mask of pad oxide, nitride layer and photoresist, and into the silicon substrate. Wolf also teaches (pages 555-557 volume 1) anisotropic plasma etching through the mask and into the substrate using a dry etch of CF<sub>4</sub> gas and that the shape of the trench (result of etch selectivity) can be altered by adjusting the fluorine-to-carbon ratio with hydrogen additions and altering the etch chemistry to make the etchant more selective toward the photoresist. Wolf teaches the chlorofluorine gas for etching nitride, silicon oxide, and silicon.

Ding teaches etching silicon oxide using fluorohydrocarbon gasses in an etching chemistry containing ammonia (NH<sub>3</sub>, a source of hydrogen, abstract) and in a magnetic field (magnetically enhanced plasma etching column 5 lines 13-15), the preferred volumetric ratio of fluorohydrocarbon to ammonia is 2.5: to 7:1 (column 2 line 57) which encompasses limitations of 40:1 to 3:1. Ding's figure 3 also shows that volumetric ratios of 10+:1 were also used, thus encompassing the limitations of "no less than 9:1. Ding also teaches using a combination of two fluorocarbons (column 9 line 65-column 10 line 4).

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JP 2000-349071 teaches an apparatus for etching silicon nitride films using either CF<sub>4</sub>, CF<sub>4</sub> and C<sub>5</sub>F<sub>8</sub>, or C<sub>5</sub>F<sub>8</sub>, with a nitrogen source (commonly ammonia) and with or without CO<sub>2</sub> gas. The use of C<sub>5</sub>F<sub>8</sub> is preferred do to improved environmental results. One skilled in the requisite art at the time of the invention would modify Wolf by including multiple fluorocarbons in conjunction with ammonia as a hydrogen source and specifically C<sub>5</sub>F<sub>8</sub> as taught by JP 2000-349071 to reduce environmental concerns, with reasonable expectation of producing a trench with better control of the etch profile angle (Ding column 1 line 55, Wolf page 552).

8. Claim 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wolf in view of Ding (US 5,814,563) and JP 2000-349071 as applied to claim 33 above, and further in view of Sugishima (US 4,352,724).

Wolf, Ding and JP 2000-349071 teach all of the positive steps of claim 36 as recited above except that the etchant may contain at least 3 fluorocarbons. Sugishima teaches the use of fluorocarbons to etch silicon, silicon oxide, and silicon nitride, (Table I) and suggests that a mixed gas of at least two of the listed chloride gasses (C<sub>2</sub>F<sub>5</sub>Cl and C<sub>2</sub>F<sub>5</sub>Cl+CF<sub>4</sub> are listed) and mixed with CF<sub>4</sub> and CF<sub>6</sub>.

One skilled in the requisite art at the time of the invention would modify the etchant of Ding containing two fluorocarbons to including 3 fluorocarbons as taught by Sugishima

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with reasonable expectation of producing a trench with controlled profile (Sugishima column 1 lines 50-52, Ding column 1 line 55, Wolf page 552).

9. Claims 7, 28, and 44-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wolf in view of Ding (US 5,814,563).

Wolf, Ding and JP 2000-349071 teach all of the positive steps of claims 7, 28, and 44-45 as recited above regarding claims 6, 18, 27, and 40 except for having an etch chemistry where the ratio of fluorocarbon to ammonia is at least 20:1.

Wolf teaches that the shape (profile) of the trench (result of etch selectivity) can be altered by adjusting the fluorine-to-carbon ratio with hydrogen additions and altering the etch chemistry to make the etchant more selective toward the photoresist.

Ding teaches etching silicon oxide using fluorohydrocarbon gasses in an etching chemistry containing ammonia (NH<sub>3</sub>, a source of hydrogen, abstract) the volumetric ratio of fluorohydrocarbon to ammonia is 2.5: to 7:1 (column 2 line 57) and shows using the process for ratios of 10+:1.

As the specification teaches ratios of 2:1 and up being used to perform the process of the instant application, the narrower ranges taught are considered to be a matter of optimization. These ranges are considered to involve routine optimization while it has



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been held to be within the level of ordinary skill in the art. As noted in re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

"Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art. Such ranges are termed "critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."

In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmischer 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).

One skilled in the requisite art at the time of the invention would have used any ranges or exact figures suitable to the method in the process of etching regarding chemistry ratios and concentrations using prior knowledge, experimentation, and observation with the apparatus used in order to optimize the process and produce the trench structure desired to the parameters desired.

### ***Response to Arguments***

10. Applicant's arguments filed 4/26/02 have been fully considered but they are not persuasive.

Most of the applicant's arguments are moot in view of the new grounds of rejection.

However, the applicant does argue that none of the cited references anticipate or

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suggest a volumetric ratio of fluorocarbons to ammonia of 40:1 to 3:1 or at least 9:1 or at least 20:1. the references teach preferred ratios of 2.5:1 to 7:1 (encompasses 40:1 to 3:1) and shows using ratios of up to 10+:1 (encompassing at least 9:1). As the disclosure teaches the invention is functional at ratios of 2:1 and up, the higher ratios are considered optimization.

### ***Conclusion***

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Blum whose telephone number is (703)-306-9168 and e-mail address is [David.blum@USPTO.gov](mailto:David.blum@USPTO.gov) .

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703)-306-2794. Our facsimile number for Before-Final Communications is (703)- 308-7722 and for After-Final Communications is (703)- 872-9319. Our receptionist's number is (703)-308-0956.

David S. Blum

May 24, 2002

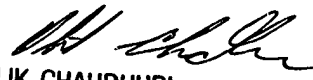
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David S. Blum

May 24, 2002

  
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